MODIS Level-1 Science Processing Algorithm
MODISL1DB_SPA

General

The NASA Goddard Space Flight Center's (GSFC) Direct Readout Laboratory (DRL), Code 606.3 developed this wrapper software for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) In-Situ Ground System (NISGS) and the International Polar Orbiter Processing Package (IPOPP).

Users must agree to all terms and conditions in the Software Usage Agreement on the DRL Web Portal before downloading this software.

Software and documentation published on the DRL Web Portal may occasionally be updated or modified. The most current versions of DRL software are available at the DRL Web Portal:

http://directreadout.sci.gsfc.nasa.gov

Questions relating to the contents or status of this software and its documentation should be addressed to the DRL via the Contact Us mechanism at the DRL Web Portal:

http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=contact%20us

Algorithm Wrapper Concept

The DRL has developed an algorithm wrapper to provide a common command and execution interface to encapsulate multi-discipline, multi-mission science processing algorithms. The wrapper also provides a structured, standardized technique for packaging new or updated algorithms with minimal effort.

A Science Processing Algorithm (SPA) is defined as a wrapper and its contained algorithm. SPAs will function in a standalone, cross-platform environment to serve the needs of the broad Direct Readout community. Detailed information about SPAs and other DRL technologies is available at:

http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=technology

Software Description

This DRL software package contains the MODIS Level 1 Direct Broadcast SPA (MODISL1DB_SPA). It processes Level 0 MODIS data into Level 1A (MOD01/MYD01) and Geolocation (MOD03/MYD03) products. It also processes Level 1A and Geolocation products into MODIS Level 1B 1km (MOD021KM/MYD021KM), half km (MOD02HKM/MYD02QKM), and quarter km (MOD02QKM/MYD02QKM) granules. The MODISL1DB_SPA functions in two modes: Standalone, or as an IPOPP plug-in.

Software Version

Version 1.0 of the DRL algorithm wrapper was used to package the SPA described in this document. This package contains the MODIS Level 1 Direct Broadcast software (MODISL1DB 1.6, December 10, 2009; updated February 1, 2010).

Version 1.6 of the MODISL1DB_SPA distribution has been updated to include Collection 6 l1bgen_modisa and l1bgen_modist programs.

The software will execute on 64- and 32- bit computers, and has been tested successfully on the following versions of Linux: Fedora 10, CentOS 5.3, Ubuntu 8.10, and SUSE 11.1.

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Credits

The algorithm was enhanced by the Ocean Biology Processing Group (OBPG) at NASA/GSFC; the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin; and the DRL at NASA/GSFC.

Prerequisites

To run this package, you must have the Java Development Kit (JDK) or Java Runtime Engine (JRE) (Java 1.5 or higher) installed on your computer, and the bin directory of your Java installation in your PATH environment variable.

Program Inputs and Outputs

See the Program Operation subsection.

Installation and Configuration

This section contains instructions for installing an SPA in a standalone configuration. SPAs may also be installed dynamically into an IPOPP framework; instructions for this type of installation are contained in the IPOPP User's Guide.

Download the MODISL1DB_1.6_SPA_1.0.tar.gz and MODISL1DB_1.6_SPA_1.0_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the MODISL1DB_1.6_SPA_1.0.tar.gz and MODISL1DB_1.6_SPA_1.0_testdata.tar.gz (optional) files:

```
$ tar -xzf MODISL1DB_1.6_SPA_1.0.tar.gz
$ tar -xzf MODISL1DB_1.6_SPA_1.0_testdata.tar.gz
```

This will create the following subdirectories:

    SPA

        modisl1db

            algorithm

            ancillary

            station

            wrapper

            testscripts

            testdata

Software Package Testing and Validation

The testscripts subdirectory contains test scripts that can be used to verify that your current installation of the SPA is working properly, as described below. Note that the optional MODISL1DB_1.6_SPA_1.0_testdata.tar.gz file is required to execute these testing procedures.

    Step 1: cd into the testscripts directory.

    Step 2: Run the 'run-l0tol1_terra' script by typing:

        $./run-l0tol1_terra

A successful execution usually takes some time (about 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck, do not become impatient. If everything is working properly, the script will terminate with a message such as:

Output modis.mxd01 is /home/IPOPP/SPA/modisl1db/testdata/output/L1ATerra.hdf

Output modis.mxd03 is /home/IPOPP/SPA/modisl1db/testdata/output/GEOTerra.hdf

The preceding script runs the Level 0 to Level 1A process. It uses the Terra MODIS Level 0 input file to produce MODIS Level 1A and Geolocation products. You can cd to the output directory to verify that the science products exist. If there is a problem and the code terminates abnormally, the problem can be identified using the log files. Log files are generated automatically within the directory used for execution. They start with stdfile* and errfile*. Please report any errors that cannot be fixed to the DRL.

To test the Level 0 to Level 1A process for Aqua MODIS, run the 'run-l0tol1_aqua' script by typing:

    $./run-l0tol1_aqua

To test the Level 1A to Level 1B process for Terra MODIS, run the 'run-l1atob_terra' script by typing:

    $./run-l1atob_terra

If everything is working properly, the script will terminate with a message such as:

Output modis.mxd021km is
/home/IPOPP/SPA/modisl1db/testdata/output/L1B1KMTerra.hdf

Output modis.mxd02hkm is
/home/IPOPP/SPA/modisl1db/testdata/output/L1BHKMTerra.hdf

Output modis.mxd02qkm is
/home/IPOPP/SPA/modisl1db/testdata/output/L1BQKMTerra.hdf

Verify that the output products exist in the output directory. Report any unusual behavior to the DRL.

To test the Level 1A to Level 1B process for Aqua MODIS, run the 'run-l1atob_aqua' script by typing:

$./run-l1atob_aqua

Test output product(s) are available for comparison in the testdata/output directory. These test output product(s) were generated on a 64-bit PC architecture computer running Fedora 10. The output products serve as an indicator of expected program output. Use a comparison utility (such as diff, hdiff, etc.) to compare your output product(s) to those provided in the testdata/output directory. Locally generated files may differ slightly from the provided output files because of differences in machine architecture or operating systems.

Program Operation

In order to run the package using your own input data, you can either use the run scripts within the wrapper directory, or modify the test script within the testscripts directory.

To Use the Run Scripts

Identify the 'run' scripts: The wrapper directory within this package contains two subdirectories, one for each of the two processes, i.e., Level 0 to Level 1A and Level 1A to Level 1B. Each subdirectory contains an executable called 'run'. You must execute the 'run' within the correct wrapper subdirectory to execute the corresponding process. For instance the 'run' within the wrapper/l0tol1 directory is for creating the MODIS Level 1A and Geolocation products, while the 'run' within the wrapper/l1atob directory should be used for creating MODIS Level 1B products. Note that to execute 'run', you need to have java on your path.

Specify input parameters using <label value> pairs: To execute the 'run' scripts, you must supply the required input and output parameters. Input and output parameters are usually file paths or other values (e.g., the satellite name). Each parameter is specified on the command line by a <label value> pair. Labels are simply predefined names for parameters. Each label must be followed by its actual value. Each process has its own set of <label value> pairs that must be specified in order for it to execute. Some of these pairs are optional, meaning the process would still be able to execute even if that parameter is not supplied. There are three types of <label value> pairs that the MODIS Level 1 SPA uses, as follows:

a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.

b) Parameter label/values. These are parameters that need to be passed onto the SPA (e.g., the name of the platform).

c) Output file labels. These are output files that are produced by the SPA. Values are the relative/absolute paths of the files you want to generate.

The following table contains labels, and their descriptions, required by the MODIS Level 0 to Level 1A wrapper.

Input File Labels	Description	Source
modis.pds	MODIS Level 0 PDS file	DRL Web Portal for recent data over the eastern US: Terra MODIS Level 0: ftp://is.sci.gsfc.nasa.gov/gsfcdata/terra/modis/level0 Aqua MODIS Level 0: ftp://is.sci.gsfc.nasa.gov/gsfcdata/aqua/modis/level0 Datasets from your Direct Readout station
gbad_eph (optional)	Near-real time ephemeris data files for Aqua	For ephemeris and attitude files corresponding to recent Aqua Direct Broadcast granules over the eastern US: ftp://is.sci.gsfc.nasa.gov/gsfcdata/aqua/gbad
gbad_att (optional)	Near-real time attitude data files for Aqua	For all other Aqua passes ephemeris and attitude files should be generated from Aqua Level 0 files using GBAD_SPA, available for download at: http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=downloads&page=technology
leapsec (optional)	Leap second file	For recent LEAPSEC files: ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/
utcpole (optional)	Earth motion file	For recent UTCPOLE files: ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/

Parameter Labels	Description
sat	Platform – 'Terra' or 'Aqua'
geocheck_threshold (optional)	The percentage of geo-populated pixels required to pass the geocheck validation test. The geocheck validation test calculates the percentage of pixels that were not successfully geolocated, and if this percentage is less than the geocheck_threshold, the processing will assume failure and will not delete temporary processing and log files (default value = 95). In IPOPP mode, this geocheck_threshold has been preset to 50.

Output File Labels	Description
modis.mxd01	MODIS Level 1A HDF file (MOD01/MYD01)
modis.mxd03	MODIS Geolocation HDF file (MOD03, MYD03)

Notes on file inputs:

1. Terra has near-real time attitude and ephemeris embedded in its Level 0 or Level 1A files, implying that you do not need to provide these inputs to the wrapper. These inputs are required for MODIS Aqua processing. Ephemeris and attitude files should be generated from Aqua Level 0 files using GBAD_SPA, available for download at: http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=downloads&page=technology. However, if you do not provide these inputs for MODIS Aqua, the SPA will attempt to use ftp to download the required files. If you plan to use the automatic download option, make sure you have an Internet connection.

2. The leapsec and utcpole inputs are also optional. They are downloaded automatically if they are not found in the SPA installation folder. If you do not wish to provide your own inputs, you need to have an Internet connection to download the required files automatically during execution. However, if you use your own inputs for these two files, it is recommended to use leapsec and utcpole input files that are not more than 14 days old.

The following table contains labels, and their descriptions, required by the MODIS Level 1A to Level 1B wrapper.

Input File Labels	Description	Source
modis.mxd01	MODIS Level 1A HDF file (MOD01/MYD01)	DRL ftp site for recent data over eastern US:
		Terra MODIS Level 1 and Geolocation:
modis.mxd03	MODIS Geolocation HDF file (MOD03, MYD03)	ftp://is.sci.gsfc.nasa.gov/gsfcdata/terra/modis/level1
		Aqua MODIS Level 1 and Geolocation:
		ftp://is.sci.gsfc.nasa.gov/gsfcdata/aqua/modis/level1
		Datasets from your Direct Readout station
modis_reflective_luts	Reflective Look-up Table (LUT)	LUTs for Terra MODIS:
		ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/terra/modis
modis_emissive_luts	Emissive LUT	
		LUTs for Aqua MODIS:
modis_qa_luts	QA LUT	ftp://is.sci.gsfc.nasa.gov/ancillary/LUTs/aqua/modis
		Note: Users should always use the latest LUTs. The most recent versions (during this release) of Aqua and Terra MODIS LUTs are available in <MODISL1DB_SPA_HOME>/algorithm/data/modisa and <MODISL1DB_SPA_HOME/algorithm/data/modist, respectively.

Output File Labels	Description
modis.mxd021km	MODIS 1km L1B Calibrated Geolocated Radiances HDF file (MOD021KM, MYD021KM)
modis.mxd02hkm	MODIS 500m L1B Calibrated Geolocated Radiances HDF file (MOD02HKM, MYD02HKM)
modis.mxd02qkm	MODIS 250m L1B Calibrated Geolocated Radiances HDF file (MOD02QKM, MYD02QKM)

Execute the 'runs': The following are examples of command lines to run the MODIS Level 0 to Level 1A process and the Level 1A to Level 1B process from the testscripts subdirectory. You can run them from the directory of your choice by using the correct paths to the 'run' scripts and your datasets.

```
$../wrapper/l0tol1/run \
modis.pds ../testdata/input/P1540064AAAAAAAAAAAAAA07093055758001.PDS \
sat Aqua \
modis.mxd01 ../testdata/output/L1AAqua.hdf \
modis.mxd03 ../testdata/output/GeoAqua.hdf \
gbad_eph ../testdata/input/P1540957AAAAAAAAAAAAAA07093055758001.eph \
gbad_att ../testdata/input/P1540957AAAAAAAAAAAAAA07093055758001.att
```

Output modis.mxd01 is /home/IPOPP/modisl1db/testdata/output/L1AAqua.hdf

Output modis.mxd03 is /home/IPOPP/modisl1db/testdata/output/GeoAqua.hdf

```
$../wrapper/l1atob/run \
modis.mxd01 ../testdata/input/L1AAqua.hdf \
modis.mxd03 ../testdata/input/GEOAqua.hdf \
modis_reflective_luts ../algorithm/data/modisa/cal/MYD02_Reflective_LUTs.V6.1.7.1_OCb.hdf \
modis_emissive_luts ../algorithm/data/modisa/cal/MYD02_Emissive_LUTs.V6.1.7.1_OCb.hdf \
modis_qa_luts ../algorithm/data/modisa/cal/MYD02_QA_LUTs.V6.1.7.1_Ocb.hdf \
modis.mxd021km ../testdata/output/L1B1KMAqua.hdf \
modis.mxd02hkm ../testdata/output/L1BHKMAqua.hdf \
modis.mxd02qkm ../testdata/output/L1BQKMAqua.hdf
```

Output modis.mxd021km is /home/IPOPP/modisl1db/testdata/output/L1B1KMAqua.hdf

Output modis.mxd02hkm is /home/IPOPP/modisl1db/testdata/output/L1BHKMAqua.hdf

Output modis.mxd02qkm is /home/IPOPP/modisl1db/testdata/output/L1BQKMAqua.hdf

A successful execution usually takes some time (approximately 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck, do not become impatient. If execution fails, you will see an error message indicating the cause of failure (e.g., a file cannot be found, or a label cannot be recognized).

Correct the problem and run again. The problem can also be identified using the stdfile* and errfile* log files. Log files are generated automatically within the directory used for execution.

To Use the Script in the testscripts Directory

One simple way to run the algorithms from any directory of your choice, using your own data, is to copy the corresponding run-xxx script from the testscripts directory to the selected directory. Change the values of the different variables to reflect the file paths of the wrapper directories and the input/output files. Then modify the input/output file name and satellite platform variables. If required add more parameters to the command line. Run the script to process your data.